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MOTIVATION AND ENGAGEMENT

Practical ideas for developing positive attitudes towards mathematics in further education colleges

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2021

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Introduction

This resource presents seven sections that are designed to motivate and engage young people who are resitting mathematics GCSE.

Many of these young people have experienced 'failure' when taking exams and during their mathematical learning journey. For this reason, they are likely to have decided that they 'can't do maths'. This resource highlights key aspects of your teaching which can help you to change their minds and show them that, with time and effort from them, and the right support from you and their peers, they can not only make progress but resit their examination successfully.

It is suggested that Sections 1–4 should be used to address negative learner 'baggage' early in the academic year. You will notice some overlap between sections and their associated activities and you may wish to adapt or combine them. Sections 5–7 may be used as the teaching year continues. As you get to know your learners, you will recognise when it is appropriate to introduce each activity to your teaching groups and each activity can be revisited several times.

Each section is based on a key idea whose use has been shown to increase students' motivation and engagement. The sections are:

1 Building the power of positive relationships

Outlines some elements of an effective student/teacher working relationship. The activities can be used in the classroom to help students understand that making mistakes is inevitable and a good opportunity for everyone to learn. The activities will also help you to be a good listener.

2 Developing positive perceptions

Encourages students to think differently about how mathematics is learned and about their ability to learn mathematics. The activity uses the Growth Zone model to help students to deal with any mathematics anxiety that they may have experienced.

3 Fostering a growth mindset

Encourages students to change their thoughts about learning mathematics. Instead of thinking that their capacity to learn mathematics is fixed, they can understand that, by thinking and working in different ways, they can grow their brainpower. The activity helps students to use more positive language when thinking about learning mathematics.

4 Building mathematical resilience

Helps students to understand that everyone has to struggle to learn mathematics. By seeking the support that they need, they can succeed. The activity helps students to identify ways of getting and using support.

5 Encouraging independent learning

Develops the idea that students have to put in the effort to learn, as no one can do the learning for them. The activity helps students to reflect on their progress and move from helplessness to taking control.

6 Encouraging 'Talk to Learn'

Explores how talking about mathematics stimulates students' thinking; communicating and thinking are intimately intertwined.[1] The activity helps students to create a safe and secure environment where everyone feels happy to talk about mathematics.

7 Valuing mathematics learning

Introduces students to examples of mathematics in everyday life, emphasising the idea that the more mathematics they understand, the more control they will have over their lives. The activities help students to recognise the mathematics around them.

1 BUILDING THE POWER OF POSITIVE RELATIONSHIPS

Key idea

The features of a positive relationship are:

- a warm environment
- respect for everyone.

This section looks at the features of positive relationships, with activities to help build these in the classroom, and gives an explanation of why they work. Use this section early in the academic year.

Features of positive relationships

1. Warm environment

A warm environment is key to good relationships. Create an ethos where:

- all students feel accepted, despite their quirks and differences
- students accept that making mistakes is a natural part of learning. If you are not making mistakes the work is too easy, and it is time to get into your growth zone (see 2 Developing positive perceptions, page xx).

2. Respect

Treat everyone with respect and challenge anyone who is disrespectful of anyone else.

- Demonstrate clearly that you value students' input and ideas. Work together to develop solutions based on everyone's insight, wisdom and creativity.
- Listen carefully to what students have to say. Listen more than you talk. Listen with an open mind and hear what they say, not what you think will be said.
- Everyone wants to feel that their work is appreciated, but too much praise can feel condescending. Make praise specific and genuine, being clear about what has been done well and why it is valued.

- Welcome diverse people and diverse opinions. Be clear there is no one right way in mathematics. There are efficient ways, and ways that students understand – which may be the same and may not.

Activities to help build positive relationships

The two activities that follow can help you achieve these positive relationships. The first allows you to create an environment in which making mistakes is seen as an important part of learning, and the second enables you to create a listening environment.

Activity – My favourite no!

Comment from teacher reviewer:

> ***'My favourite no!*** is my favourite part of the resource. Mistakes are very powerful tools for learning.'

Use this activity to build an environment where students do not worry about making mistakes, but use them as opportunities to learn.

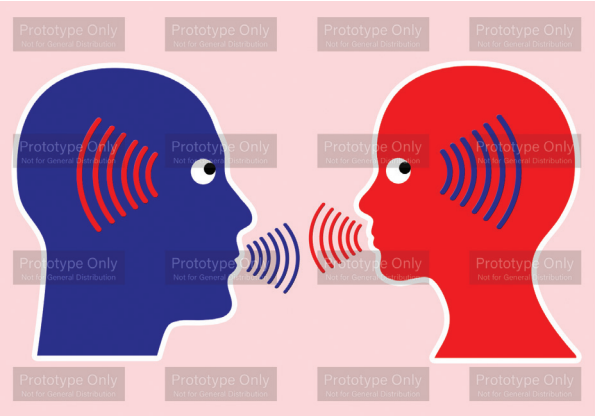
You will need:
Rough paper, 1 sheet per student

What you will do:

1. Find a mathematics question that you expect many in the class to make mistakes in answering, perhaps a question about something challenging from the last session. Display it as students enter the classroom.
2. Give each student a piece of rough paper as they enter the room. Tell them you want to know what they are thinking and how they feel they should approach the question, so getting the answer right is less important than showing how they think they could answer it. They must NOT put their name on the paper.

3. Collect in the rough papers and look at each sheet, dividing them clearly into 'That's right' and 'That's interesting'. Pick out an interesting one that illustrates a common misconception, saying, 'This is my favourite no!'
   Write the contents of the paper on the board, saying 'This is what was on the paper. This is a really interesting mistake. Let's see what we can learn from it.'
4. Ask, 'Who can spot a mistake?', 'What might the person who wrote this have been thinking?' or 'What might have gone wrong here?'.
5. Explore two or three other interesting mistakes in the same way.

Activity – Listening to students



Active listening is important in teaching, but first you have to get students talking. There are ideas for this in 6 Encouraging 'Talk to Learn', page xx.

During the discussion, listen carefully to students' ideas, showing that they are valued and using their ideas to consolidate the learning.

What you will do:

1. Tell students not to put up their hands as you will pick someone to answer. Wait at least 3–5 seconds before asking anyone to give a response. This will feel like a long time but do it anyway. It makes a difference.
2. When you ask for a response, value students' answers by listening carefully to them. This will help to build positive esteem.
3. Wait while the student completes their answer. Don't jump in before they have finished.
4. Write exactly what the student says on the board and then discuss it. Whether it is right or wrong, there will be something to learn from it.

Why this works

The research is clear: student-teacher relationships significantly impact teacher effectiveness and student achievement. When Hattie synthesised 800 meta-analyses relating to achievement, he found that teachers who create positive teacher-student relationships are likely to have a beneficial effect on student achievement.[2] He clarified the features of these relationships

as empathy, warmth, encouragement, authenticity, and respect for student backgrounds. A student who feels respected, cared for, and connected to their teacher has increased motivation to listen, learn and achieve.

The 'My favourite no!' activity shows students that progress is made by making mistakes, identifying and correcting them. The listening activity boosts students' confidence by reinforcing that their ideas have value.

More information available from…

- Hattie, J. (2009), *Visible Learning* (Routledge: Abingdon)
- 'Why Strong Teacher Relationships Lead to Student Engagement and a Better School Environment', *Waterford.org*. Available at: https://www.waterford.org/education/teacher-student-relationships/

2 DEVELOPING POSITIVE PERCEPTIONS

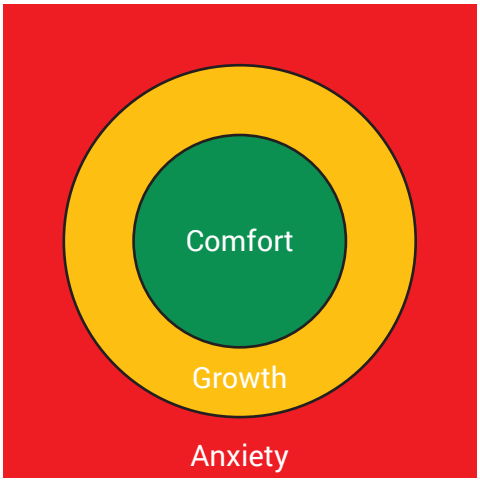
Key idea

Students learn mathematics better when they have positive perceptions of it.

Students often have negative perceptions about mathematics. This section explains how these negative perceptions may have developed, and introduces the Growth Zone Model activity, which can help change negative perceptions to positive. Use this section early in the academic year.

Students are often told to 'remember this' when learning mathematics, rather than being asked to understand the underlying concepts or to connect new concepts with what they know already. This can start when students are very young. It can lead to the idea that they 'can't do maths' as they find it hard to remember everything. They may also have been told 'it's easy if you do it this way' and, when they find learning a struggle, they again conclude they 'can't do maths'. They develop negative perceptions about mathematics.

The Growth Zone Model helps students understand their feelings when they are learning mathematics. It gives them (and you) the language to talk about their feelings and understand that when they are learning or growing their mathematics, it can make them feel somewhat uncomfortable and as though they are taking a risk. However, staying comfortable means they are not learning. Many students do not know this.



The Growth Zone Model

Activity – Using the Growth Zone Model

This activity asks students to think about what it feels like when they are learning.

You will need:

- the Growth Zone Model resource sheet on page xx
- the Growth Zone Model PowerPoint.

What you will do:

1. Give a copy of the resource sheet to each student and introduce the Growth Zone Model.
2. Ask students to think about which zone they are usually in when they are working in mathematics. Are they comfortable but slightly bored? Are they experiencing the good stress that goes with learning? Are they feeling anxious and panicky?
3. Spend some time getting students to think about this and suggest how they might get support when they need it. They may need strategies to support themselves – it cannot always be teacher support as there are many of them and just one of you. You may find it useful to combine this activity with 'Making a 'stuck' mind map' on page xx.
4. Ask students to place themselves on the Growth Zone Model a couple of times during each of the next few lessons. See slide 3 of the PowerPoint presentation.
5. Get students used to the idea that learning mathematics is not easy but, once they have worked out what support they need, they should be able to stay longer in the growth zone.

Feedback from a teacher who used the activity:

He related the activity to the online learning students had done during lockdown. It helped to address the issues they had experienced with this and how they would change moving forward. The activity gave the teacher a useful insight into what the students had felt.

This teacher chose to use this activity and **4 Building mathematical resilience** in the same lesson.

Why this works

The Growth Zone Model can be used to help students to change the way they think about mathematics and to change negative perceptions to positive.[3] It is important that students understand that learning mathematics can be a struggle and feel risky. Anxiety prevents learning but using strategies to help themselves (or seeking support elsewhere) should help them reduce their anxiety.[4] The Growth Zone Model provides students with the language to express their feelings when learning mathematics.

More information available from…

- Johnston-Wilder, S. and Lee, C. (2018), 'Getting into and staying in the Growth Zone'. Available at: https://nrich.maths.org/13491
- 'The Growth Zone Model', *Highland Council Psychological Service*. Available at: https://stagedinterventionhighland.files.wordpress.com/2019/12/the-growth-zone-model-edited.pdf

The Growth Zone Model

Resource sheet

There are three zones: comfort, growth and anxiety.
What does it feel like to be in each zone?
When you are in the...

... comfort zone...
... you feel safe.
... you practise to make sure you can do things.
... you repeat things so that you can do them without too much thought.
... you sometimes feel bored as you are doing the same thing over and over again.
... you don't learn new ideas.

... growth zone...
... you feel like you are taking a risk.
... you don't know what to do at times.
... you struggle sometimes.
... you make mistakes and do things wrong because you are learning.
... you need the right support for you to stay in this zone.

... anxiety zone...
... you feel it's all too much.
... you feel panicky.
... you can't learn because you are anxious.
... you might need to go back to the comfort zone and start again.
(Breathe – be kind to yourself.)
... you must not give up – you can do it – seek and get support.

Which zone are you in now? Try to stay in your growth zone by working out what support you need and how you might get it.

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3 FOSTERING A GROWTH MINDSET

Key idea

A growth mindset is a belief that intelligence can be developed and grow over time.

It is easy for students to get discouraged when learning mathematics and to have negative thoughts about their capacity to learn. This section includes an activity that can promote a growth mindset among students and persuade them that their mathematical ability is not fixed but can be improved. Use this activity early in the academic year.

Activity – What can I say to myself to help my mind grow?

You will need:

- one set of the cards on page xx, cut out, for each pair or small group
- optional video: this video outlines the main characteristics of a growth mindset and finishes with a reluctant mathematics student explaining why a growth mindset has improved her mathematics learning. (4 mins 5 secs) https://www.youtube.com/watch?v=d0jEF66xSBA

Fixed mindset versus Growth mindset

What you will do:

1. Remind students that a growth mindset is the belief that intelligence is not fixed, but that it can be developed and grow over time if students put in the time and effort. This leads to higher attainment. They will probably have learned about this earlier in their school career. If not, you could show the video clip mentioned above.
2. Hand out the cards from the 'What can I say to myself to help my mind grow?' resource sheet.
3. Tell students that this activity will help them use more positive language when they feel discouraged in their learning of mathematics. This language will help them develop a growth mindset for mathematics learning.
4. In groups or pairs, ask students:
   - **a)** to match one or more positive language cards to a negative statement. They don't have to do them all.
   - **b)** if there is time, to add their own examples of negative statements they might make and how they could rephrase these in a more 'growth mindset' way.
5. Invite the groups or pairs to share some of their ideas.
6. Ask students to make a copy of their 'What can I say to myself?' ideas, for example by taking a picture of their sorted cards. They can use the picture whenever they need encouragement in their mathematics learning.

Why this works

When students adopt a growth mindset as opposed to a fixed mindset, they believe that their capacity to learn is not fixed, but can be developed and grow over time.[5] With extra time, effort and support, this leads to higher attainment. Neuroscience supports this belief. Connectivity between neurons increases with thinking: new connections grow between neural networks and existing ones are strengthened, embedding and consolidating learning.[6] Effective learning strategies, asking questions and practising have been shown to do this.

Comment from teacher who observed this activity in the classroom:

"

'When I saw it on paper, I was a little bit cynical about it. I thought 'that's not going to work. It is a waste of time'. However, it was really good. The teacher I observed loved it and used it for a whole week.'

"

More information available from…

- To learn more about growth mindset: https://www.mindsetworks.com/science/
- To learn more about growth mindset in the context of mathematics learning: https://www.youcubed.org/

‘What can I say to myself to help my mind grow?’

Resource sheet

Cut out the cards and sort them under these headings.

Instead of...		Try saying...
I’m not good at this.	This is the best I can do; it will have to do.	This might take some time and effort.
I made yet another mistake.	One step at a time. What do I understand or recognise about this problem?	I give up.
This is useless – I just can’t do maths.	What am I missing?	What strategies could I use to get unstuck?
I can’t do this yet, but with some more effort I will be able to do this.	This is way too hard for me.	I think I am on the right track.
I can’t think of any other way to solve this problem and what I have tried has not worked.	How could I improve this further?	Mistakes help us learn. What did I do wrong?

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4 BUILDING MATHEMATICAL RESILIENCE

Key idea

Progress in mathematics involves challenges and struggles.

Making progress in mathematics inevitably involves some struggles and occasionally a feeling of being 'stuck'. Since teachers do not always have the time to personally 'unstick' individual students, it is important that students develop strategies to support themselves. This section includes a mind map activity that helps students to compile a collection of strategies that they could use to solve their own sticking points individually, in pairs or in small groups.

Before completing the mind map activity, read the following and notice how helping the student to help himself changed his mindset.

A true story

An observer went into a classroom to observe the teaching of a trainee teacher. She noticed that a student at the back of the room was idle and went to talk to him. The conversation went something like this.

Observer Why aren't you doing what you have been asked to do?

Student I don't understand it.

Observer What don't you understand?

Student All of it.

Observer Read me the first sentence.

Student reads sentence aloud.

Observer Do you understand this sentence?

Student Yes.

The process is repeated for the second sentence.

The student realises this is going to be repeated sentence by sentence, gets exasperated and says, 'That's the bit I don't understand.'

The observer continues to gently question until the student identifies his exact sticking point, solves his own problem and refuses to stop working when asked to because he now knows he can succeed at the task.

The most poignant part of the conversation for the observer was when the student said 'You've made me feel really clever'.

Activity – Making a 'stuck' mind map

What you will do:

1. Outline the rationale for this activity, emphasising that being 'stuck' is where new learning can begin. Before they got stuck, learners knew what they were doing and were not learning anything new. (See also The Growth Zone Model in 2 Developing positive perceptions, page xx).

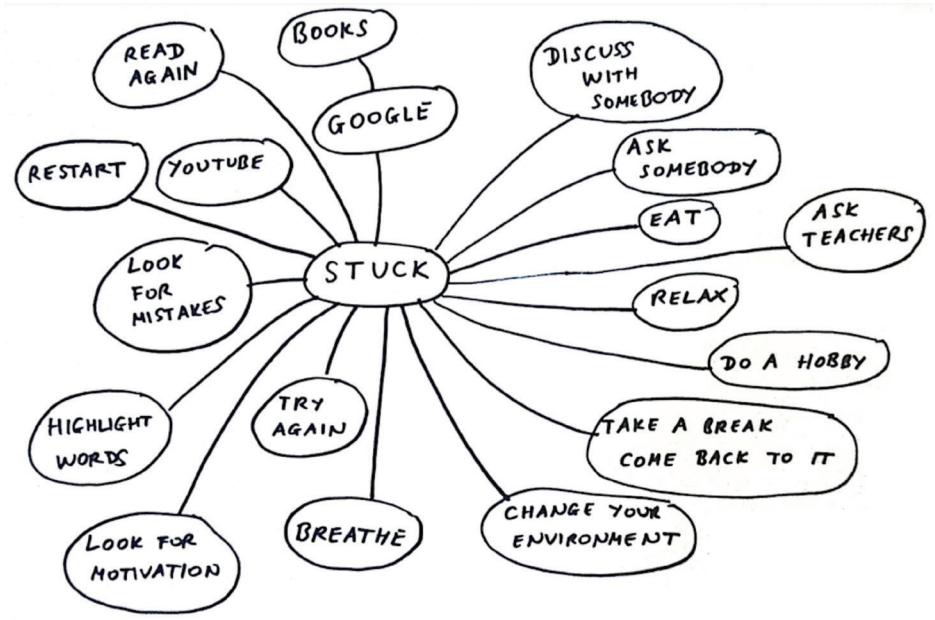
- Ask students to recall a situation in or out of the classroom where they got stuck and ask them what they did to get unstuck. List all of the suggestions on the board without commenting on them.
- Now ask students which of these strategies might work in a mathematics lesson and place an asterisk by these.
- Add in other suggestions which might be unique to mathematics learning.
- When you have a good collection of ideas, ask students to pick the four or five that they personally would find most useful. They should note these in their books as memory joggers for the next time they get stuck.

2. Here are some ideas suggested by a group of students.

- Read the question again, slowly. It may make sense the second time round.
- If there are words you don't understand, find out what they mean. You might use books, notes or the internet, or try asking a friend or a teacher ….
- Find the important words in the question.
- Draw a diagram or a picture.
- Ask yourself a question, for example:
  - What do you notice?
  - What do you know?
  - What can you do with what you know?

- Ask others for support. Recognising the need for support is a sign of strength and results in learning. Trying to hide a weakness feels like failure and no learning takes place.

3. Here are some ideas from another class who tried out this activity.



Why this works

Students who have experienced 'failure' may have concluded that there is no point in attempting any task they find.[7] They feel they 'know' that they will not be able to do it. This activity helps students to understand that:

- getting stuck is part and parcel of the process of learning;
- struggling and being 'stuck' are to be celebrated rather than avoided, as they indicate that learning is taking place;[8]
- there are straightforward ways in which they can help themselves to become 'unstuck'.

More information available from…

'Developing mathematical resilience' – an eight-page pamphlet explaining the concept of mathematical resilience in more detail. Available at: http://www.mathematicalresilience.org/papers.htm

Johnston-Wilder, S. and Lee, C. (2010), 'Mathematical resilience', *Mathematics Teaching, MT218, 38–41*. Available at: http://www.atm.org.uk/journal/archive/mt218.html

5 ENCOURAGING INDEPENDENT LEARNING

Key idea

Students learn better when they develop independence and ownership of their mathematics learning.

Becoming an independent learner is vital, as students will need to learn throughout their lives but will not always have access to a teacher. Self-assessment is one way to build independent learning skills.

This section includes a self-assessment activity that can be used in any lesson – either the whole activity or just a part of it. It is important that it does not become another 'thing to do' for students, because then it would lose its effectiveness.

Comment from teacher reviewer:

"'It's very useful for students to set their own targets so that they know what they have to do.'"

Activity – Self-assessment for independent learning

This activity sheet is inspired by a self-assessment task in Jo Boaler's book *Mathematical Mindsets* (2015), p.244.[9]

Before you start:

Decide whether you are going to provide the learning outcomes that need to be added to the resource sheet, or whether students will do that with you.

You will need:

- a copy of the self-assessment sheet on page xx for each student, with or without the learning outcomes filled in.

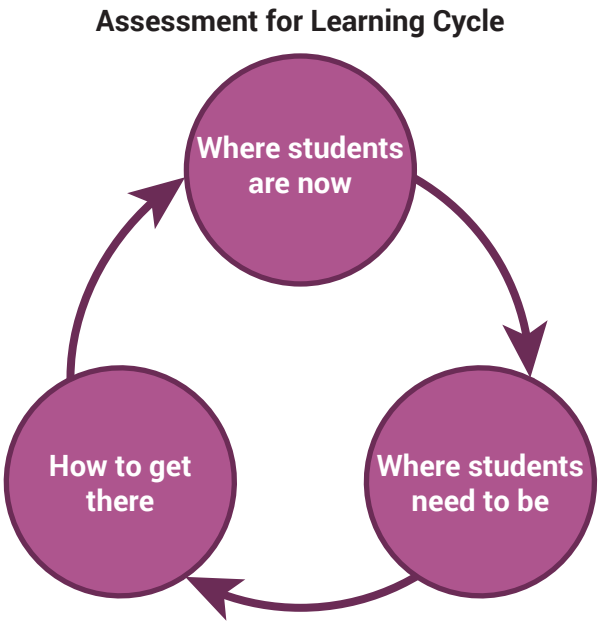
What you will do:

1. Discuss with students why they think it is important to become an independent learner, what appeals to them about becoming an independent learner and what they do not like about it (or are worried about). This discussion only needs to be done the first time that you use the self-assessment sheet in the classroom.
2. Hand out the self-assessment sheet.
3. Tell students that the self-assessment sheet is designed to help them reflect on where they are now and what they can do next to get better at mathematics, get better at learning mathematics and feel better as learners of mathematics.
4. Discuss the learning outcomes for this lesson with students and how they will help them see progress in their learning. Either look at the outcomes you have added to the worksheet or ask them to add the learning outcomes discussed to the sheet.
5. Ask students to complete the self-assessment sheet and tell them you will discuss later whether they think this can help them to become a better learner of mathematics.
6. In groups or pairs, ask students:
   - **a)** to identify what they like and don't like about the sheet
   - **b)** to discuss how it could help them to become more independent learners
   - **c)** to identify any changes they would like to make to the sheet.
7. Invite the groups or pairs to share some of their thoughts and ideas.
8. Decide as a class what suggested changes to take on board and change the sheet. Students can also make their own personal changes to the sheet.
9. Use this sheet in future lessons (with appropriate learning outcomes) and ask students regularly whether anything on it needs changing to help them become more independent learners.
10. When students have used the sheet during a lesson, encourage them to think of how they could move on from any 'I can't quite do this' responses. Discussing students' responses with them will also help you identify students who are becoming anxious or demotivated.

Why this works

Actively involving students in making decisions about their learning helps them develop as independent learners who have the power to act for themselves. The activity asks students to reflect, assess their progress and identify what steps they could take next. It builds on research evidence on Growth Mindset[9], on Assessment for Learning[10] and on the Assessment for Learning Cycle.

Formative self-assessment motivates students by convincing them that they can improve their learning through their own personal effort. When individual assessment for learning is used effectively, Clare Lee says that students are able 'to be self-efficacious, they know how to learn and self-regulate, they can steer their own learning, and their self-esteem, and therefore their motivation – is high.' [11]



The Assessment for Learning Cycle

More information available from…

- 'What formative assessment is and isn't?'. Available at: https://larryferlazzo.edublogs.org/2020/04/18/video-dylan-wiliam-on-what-formative-assessment-is-and-isnt/
- 'Practical Ideas for Classroom Formative Assessment'. Available at: https://www.dylanwiliamcenter.com/2015/02/03/practical-ideas-for-classroom-formative-assessment/
- Boaler, J. and Confer, A. 'Assessment for a Growth Mindset'. Available at: https://www.youcubed.org/downloadable/assessment-growth-mindset/

Self-assessment for independent learning

Resource sheet

This activity is designed to help you reflect on where you are now and what you can do next to get better at maths, get better at learning maths and feel better as a learner of maths. It is personal and you should write what you want in the way you want. It should help you to become a more independent learner.

Write the learning outcomes for the lesson in the left-hand column. Tick the box next to each learning outcome to show how you feel.

Learning outcomes for the lesson or for a series of lessons. They can be broken down into smaller steps if wished. e.g. Identify 2-digit prime numbers.	 I can do this AND explain it to a friend.	 I can do this.	 Hmm, I can't quite do this yet. (*Add what could help you, e.g. spending some more time on it, seeing more examples....*)

	 Totally agree	 A little, yes	 Not quite sure
In this lesson, I understood more about how to learn maths.			
What helped me understand more about how to learn maths was...			
I felt better as a maths student.			
I feel better as a maths student when...			

To make sure I can do exam questions on this topic, I should do the following:

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6 ENCOURAGING 'TALK TO LEARN'

Key idea

Talking about mathematics stimulates students' thinking; communicating and thinking are closely linked.

An environment where students feel comfortable talking about mathematics with each other is important. The more talking they do, the more thinking they do, as communicating and thinking are closely.[11] Talking and thinking will help them learn mathematical ideas. Encouraging students to talk to each other may also help to identify and correct any misconceptions, as students will feel comfortable about making mistakes. This section includes an activity to establish ground rules for 'Talk to Learn'.

Activity – Establishing ground rules for 'Talk to Learn'

This activity asks students to think of ground rules that will make all of them feel safe and secure to use 'Talk to Learn' and discuss mathematics with each other.

What you will do:

1. Ask students to discuss in pairs or small groups what they consider a safe environment where they feel able to talk about mathematics, and what makes them not want to contribute.
2. Discuss with students why they think it is important for them to feel safe and secure when using 'Talk to Learn'.
3. Ask students to think back to a session (any subject, any year) where they used 'Talk to Learn' and when they felt safe and secure in doing so. What was it that made them feel that way?

4. Introduce and discuss the idea that to feel safe and secure, it means being able to say 'yes' to the questions:
   - **a)** Do I feel safe here to talk about maths?
   - **b)** Will what I contribute be seen as adequate?
   - **c)** Can I trust others to respond in a constructive way?
   - **d)** Can I trust myself to talk about maths and to respond in a constructive way?
5. In groups, ask students to write the five ground rules that would have the most impact on creating a safe and secure learning environment for 'Talk to Learn'.
6. Invite groups to share their ideas for ground rules, and to decide as a class on a list that they think will be effective and that they are prepared to follow. Write these on a flipchart that can be displayed, modified or added to in subsequent sessions or start a 'Ground Rules' PowerPoint slide which you will use and add to whenever you use 'Talk to Learn'.
7. After doing some activities where they used 'Talk to Learn', ask students to reflect on and reconsider their ground rules. Did they manage to use them well? Do any of them need changing?

Why this works

Effective 'Talk to Learn' requires students to open their minds, listen to what others say and share their own thinking. They must feel comfortable about making mistakes, airing misconceptions, or proposing a new idea without fear of ridicule or being made to feel they are 'stupid'. The ground rules activity is intended to set out how students will behave in order to create and maintain a safe and secure learning environment; not only physically safe, but also psychologically, emotionally and intellectually safe. The classroom should be an environment where each student feels their ideas and contributions will be respected and that they will be supported by everyone in it. The four questions in point 4 above are important in making it clear that in order for everyone to feel safe and able to contribute in an environment, each individual must feel safe to talk, that their contributions are valued and will be adequate, that they can trust others to respond constructively and that they can trust themselves.[12]

The ground rules activity will help you to establish a safe and secure learning environment in the classroom through including rules on how students should talk and listen to each other and give constructive feedback. It is very important that ground rules are not imposed on students, but instead developed with or by them, so that they agree to follow them and feel confident to remind others of them too.

More information available from…

To find out more about why 'Talk to Learn' is an effective learning exercise:

- Swan, M. (2006), *Collaborative Learning in Mathematics: A Challenge to Our Beliefs and Practices* (London: National Institute of Adult Continuing Education)
- 'Key resource: talk for learning', *TESS-India*. Available at: http://www.open.edu/openlearnworks/mod/oucontent/view.php?id=56846&section=3

Ideas for activities which support 'Talk to Learn':

- 'Improving learning in mathematics'. Available at: http://wirksworthii.nottingham.ac.uk/Improv_Learning_Maths/screens/math_004_001_005/page.html

7 VALUING MATHEMATICS LEARNING

Key idea

Mathematics is valuable in the workplace and in everyday life.

Unfortunately, some people take a pride in their lack of mathematical competence and they influence the attitude of others towards the subject. The activities in this section attempt to show that mathematics is of value to everyone.

The first activity can be used at any time. In this activity, students will need to use their mathematical knowledge to spot and challenge misleading information. Once you have used the examples shown in the resource sheet, you could encourage students to look out for their own examples and show interesting ones to the rest of the class.

The second activity could be appropriate when students claim that the work they are engaged in would never be useful. In this activity, students look at where mathematics is used in different careers.

Activity – Don't get bamboozled!

This activity asks students to start thinking about the mathematics they may encounter in daily life. It provides ways to start this thinking rather than covering any scenario in depth.

You will need:

- one set of cards on page xx depicting mathematical situations for each group
- the PowerPoint presentation 'Don't get bamboozled!'.

What you will do:

1. Explain to students that what they see and hear in the media is not always correct. They will need to use their mathematical knowledge to enable them to spot and challenge misleading information.
    - Show students slide 2 on the presentation and ask them what they notice. Spend a few minutes taking comments about what they see in the picture and whether they have seen similar 'mistakes' elsewhere.
2. Put students into groups of three or four and give each group a set of cards.
    - Ask students to choose one or two of the cards and to discuss the image on the card. Remind them of the ground rules for working together effectively (see 'Talk to Learn' on page xx).
3. Circulate round the room listening to the discussion and noting any comments which you feel should be shared with the whole group.
4. Using slides 3–8, finish the activity by sharing key comments from the groups on the need for them to be mathematically literate.

Activity – Mathematics in the workplace

One reason why resit students do not value mathematics is that they cannot see its relevance, as they have limited knowledge of the world of work. In the future they may change jobs several times and work in industries which do not yet exist. It is not possible to anticipate what mathematics they will need in these new fields, but they can be helped to understand the importance of mathematics by looking at current careers and drawing their attention to the mathematics used there.

You will need:

- Access to the MEI Contextualisation toolkit, found here https://mei.org.uk/contextualisation-toolkit

What you will do:

1. With the help of the MEI tool and other online resources, use examples of mathematics in the workplace in your lessons. This may take the form of anecdotes, photographs, short video clips or a visit from a vocational lecturer. Try to show mathematics relevant to your students but don't limit what you discuss.

2. Use some of these examples from the construction industry:
Maths and plumbing
https://www.youtube.com/watch?v=6SmDO4T1OdE&feature=youtu.be
Pythagoras in construction
https://www.youtube.com/watch?v=gjqJwdqQZy0&feature=youtu.be
Maths in construction
https://www.bbc.co.uk/teach/skillswise/construction/zmcghbk

Why this works

Students often feel that there is no point in learning mathematics, as they will not need this knowledge when they finish their education. The two activities offer examples showing them that mathematics is everywhere and that they will encounter it in both everyday life and in whatever job they may have. Being prepared to use mathematics and think mathematically is and will be important. They will have to do some mathematical thinking in every job. The better they are at it, the better they will do their job. They also need to know that sometimes what they read or see on the television is just plain wrong!

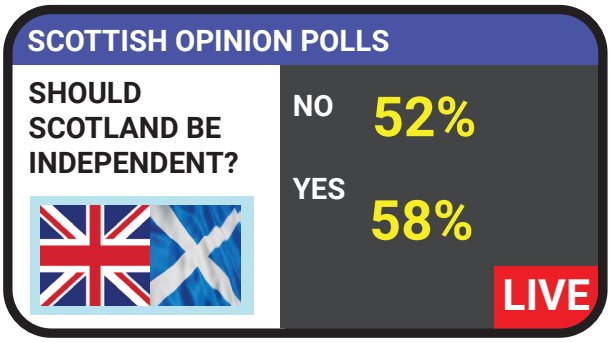
More information available from…

- Boaler, J. (1993), 'The Role of Contexts in the Mathematics Classroom: do they make mathematics more real?', *For the Learning of Mathematics*, 13 (2): 12–17.
- Ellenberg, J. (2015), *How Not to Be Wrong: The Hidden Maths of Everyday Life* (Penguin: London)
- Ward-Penny, R. (2010), *Cross-Curricular Teaching and Learning in the Secondary School* (Routledge: Abingdon)

Don’t get bamboozled!

Resource sheet

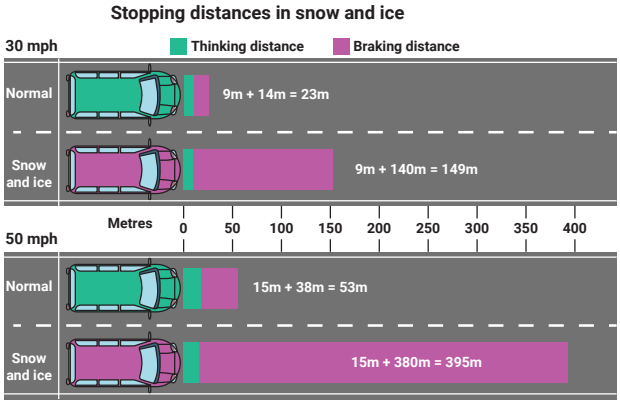
What is wrong with this?



If the TV star had been travelling at 98 km/h, would he have been breaking the speed limit?

What is wrong with this? What should it say?

Do these diagrams make sense?



Is it worth buying two?

Comment on this

Comment on this

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[9] Boaler, J. (2015), *Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages and innovative teaching* (John Wiley & Sons)

[10] Wiliam, D. (2011), *Embedded Formative Assessment* (Bloomington, IN: Solution Tree Press)

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[12] Senge, P., Kleiner, A., Roberts, C., Ross, R., Roth, G., & Smith, B. (1999), *A Fifth Discipline: The Dance of Change: The Challenges of Sustaining Momentum in Learning Organizations* (Currency Doubleday: New York)